DOCUMENT RESUME

ED 115 815 95 CE 005 638

AUTHOR Yoder, Edgar P.; McCracken, J. David
TITLE An Empirical Determination of Tasks Essential to Successful Performance as an Agricultural-Industrial Equipment Mechanic. Determination of a Common Core of Basic Skills in Agribusiness and Natural Resources.
INSTITUTION Ohio State Univ., Columbus. Dept. of Agricultural Education.; Ohio State Univ., Columbus. Research Foundation.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
BUREAU NO V0033VZ
PUB DATE 75
GRANT OEG-0-74-1716
NOTE 34p.; For an explanation of the project, see CE 005 614-615, and for the other occupations, see CE 005 616-643

EDRS PRICE MF-$0.76 HC-$1.95 Plus Postage
DESCRIPTORS Agricultural Education; *Equipment Maintenance; *Farm Mechanics (Occupation); Job Analysis; *Job Skills; Motor Vehicles; *Occupational Information; Occupational Surveys; Off Farm Agricultural Occupations; Service Occupations; Tables (Data); *Task Analysis; Vocational Education

ABSTRACT

To improve vocational educational programs in agriculture, occupational information on a common core of basic skills within the occupational area of the agricultural-industrial equipment mechanic is presented in the revised task inventory survey. The purpose of the occupational survey was to identify a common core of basic skills which are performed and are essential for success in the occupation. Objectives were accomplished by constructing an initial task inventory to identify duty areas and task statements for the occupation. The initial task inventory was reviewed by consultants in the field, and 456 tasks were identified. A random sample of 70 agricultural-industrial equipment dealerships based on the 1975 directory of the Association of Farm and Power Equipment in Ohio was obtained. Data were collected utilizing employer and employee questionnaires. Thirty-one questionnaires were returned of which 30 were usable. A compilation of basic sample background information is presented on size of dealership, total work experience, employment at current job, and preparation as a mechanic. A compilation of duty areas of work performed and work essential for the occupation is given. Percentage performance by incumbent workers and the average level of importance of specific task statements are presented in tabular form. (Author/EC)

Documents acquired by ERIC include many informal unpublished materials not available from other sources. ERIC makes every effort to obtain the best copy available. Nevertheless, items of marginal reproducibility are often encountered and this affects the quality of the microfiche and hardcopy reproductions ERIC makes available via the ERIC Document Reproduction Service (EDRS). EDRS is not responsible for the quality of the original document. Reproductions supplied by EDRS are the best that can be made from the original.

ED115815

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

THE OHIO STATE UNIVERSITY

AN EMPERICAL DETERMINATION OF TASKS ESSENTIAL TO SUCCESSFUL PERFORMANCE AS AN AGRICULTURAL-INDUSTRIAL EQUIPMENT MECHANIC

Edgar P. Yoder

J. David McCracken

Department of Agricultural Education
in cooperation with
The Ohio State University Research Foundation
The Ohio State University
Columbus, Ohio
1975

PREPARED AS APPENDIX XIV

Of A Final Report

On A Project Conducted Under

Project No. V0033VZ

Grant No. OEG-0-74-1716

This publication was prepared pursuant to a grant with the Office of Education, U.S. Department of Health, Education and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official U.S. Office of Education position or policy.

U.S. Department of Health, Education and Welfare
U.S. Office of Education

FOREWORD

The Department of Agricultural Education at The Ohio State University is involved in a major programmatic effort to improve the curricula in educational programs in agriculture. One product in this effort is this report of the agricultural-industrial equipment mechanic task inventory survey. The data reported were collected as part of a more comprehensive thrust designed to develop a common core of basic skills in agribusiness and natural resources.

It is hoped that the revised task inventory contained in this report will be useful to curriculum developers working for improved occupational relevance in schools. Twenty-seven additional inventories in other occupational areas are also reported from this project.

The profession owes its thanks to Edgar Yoder, graduate research associate, for his work in preparing this report. Special appreciation is also expressed to William Davidson, Executive Director, Association of Farm and Power Equipment Retailers in Ohio, for his input and help in securing the cooperation of those employed in this occupational area.

J. David McCracken
Project Director

TABLE OF CONTENTS

	Page
FOREWORD	iii
LIST OF TABLES	v
INTRODUCTION	1
Purpose and Objectives	2
Definition of the Occupational Area	2
METHODOLOGY	2
Initial Task Inventory	2
Initial Inventory Validation	3
Worker Sample Selection	3
Data Collection	4
Data Analysis	4
FINDINGS	5
Description of the Sample	5
Duty Areas of Work Performed by the Mechanic	7
Duty Areas of Work Essential for Successful Performance as a Mechanic	10
Percentage Performance and Level of Importance Ratings of Specific Tasks	11

LIST OF TABLES

TABLE		Page
I	Employee Response to the Questionnaire	6
II	Size of Agricultural-Industrial Equipment Service Department Where Currently Employed. . .	6
III	Total Amount of Work Experience in the Agricultural-Industrial Equipment Industry . . .	8
IV	Length of Time at Present Job.	8
V	Source of Training Received as an Agricultural-Industrial Equipment Mechanic.	9
VI	Percentage Performance and Average Rating of Importance of Specific Tasks	12

INTRODUCTION

Occupational information is needed to develop and revise vocational and technical education curricula. Teachers and curriculum developers generally determine which skills might be taught in a program based upon teacher expertise, advisory committee input, informal and formal community surveys, and/or task inventories.

The Agricultural Education Department at The Ohio State University has utilized and revised a system for obtaining and using occupational information as an effective aid in planning, improving, and updating occupational education curricula. This report presents the results of a task analysis survey of the occupation, agricultural-industrial equipment mechanic. The information contained herein may be used by curriculum development specialists, teachers, local and state administrators, and others involved in planning and conducting vocational and technical programs in agriculture.

Purpose and Objectives

The major purpose of the occupational survey was to identify the skills which are performed and essential for success as an agricultural-industrial equipment mechanic. The specific objectives of this survey were as follows:

1. Develop and validate an initial task inventory for the agricultural-industrial equipment mechanic.
2. Identify the specific tasks performed by agricultural-industrial equipment mechanics.
3. Determine the relative importance of the specific tasks to successful employment of agricultural-industrial equipment mechanics.

Definition of the Occupational Area

The agricultural-industrial equipment mechanic works in the service department of the agricultural-industrial equipment dealership and at times may be required to make repairs in the field. The specific duties of the mechanic will vary with the type and size of business. The mechanic will inspect and diagnose equipment malfunctions; maintain, overhaul, and repair engines, power trains, steering systems, brake systems, air conditioning units, hydraulic systems, electrical and ignition systems, fuel systems, and cooling systems. Additionally, the mechanic will repair and adjust agricultural harvesting equipment, labor savings and materials handling equipment, agricultural planting equipment, agricultural spraying equipment, and agricultural tillage equipment. In many agricultural-industrial equipment dealerships the mechanic will also be involved in repairing industrial and construction equipment such as backhoes, bulldozers, highlifts, and ditchers. Depending on the size of business, the mechanic may specialize in one or two of the areas.

METHODOLOGY

Objectives were accomplished by constructing an initial task inventory, validating the initial inventory, selecting a sample of workers, collecting data, and analyzing data.

Initial Task Inventory

Duty areas and task statements for the agricultural-industrial equipment mechanic were identified by searching existing task

lists, job descriptions, curriculum guides, reference publications, and service manuals. Additionally, contacts with several industry personnel aided in clarifying the specific responsibilities of the agricultural-industrial equipment mechanic. All the tasks that the project staff thought to be performed were assembled into one composite list.

The initial tasks were grouped into functional areas called "Duties".

After the task statements were grouped under the proper duty areas, each task statement was reviewed for brevity, clarity, and consistency. In all, 537 task statements were included in the initial task inventory.

Initial Inventory Validation

After the initial task inventory was constructed, it was reviewed by 12 consultants employed in agricultural-industrial equipment dealerships. These consultants were either shop service managers, dealership owners, or mechanics.

The consultants were asked to respond to the initial task list inventory by performing the following activities:

1. Indicate whether any of the tasks listed were not appropriate.

2. Add any additional tasks they believed were performed by agricultural-industrial equipment mechanics.

3. Make changes in the wording of tasks to help add clarity to the statements.

The comments from the 12 consultants were pooled and needed revisions were made. Four duty areas were eliminated and two duty areas were combined. Three new duty areas were added.

As a result of the initial task inventory review process, 456 tasks were identified.

Worker Sample Selection

Since the specific duties and tasks performed by individual agricultural-industrial equipment mechanics are related to the size and type of business where employed, an attempt was made to survey mechanics employed in various sizes and types of equipment dealerships. It was not possible to secure a list of the specific names and addresses of all incumbent workers in the state. Therefore, a sample of 70 agricultural-industrial equipment dealerships

was obtained from the 1975 directory of the Association of Farm and Power Equipment Retailers in Ohio using a stratified random sampling approach. The strata used in sample selection were type of business and geographical location.

Data Collection

A packet of materials was sent to the owner or manager of the randomly-selected agricultural-industrial equipment dealerships. The packet of materials included:

1. A cover letter from the Association of Farm and Power Equipment Retailers in Ohio.
2. An employer questionnaire printed on blue.
3. An employee questionnaire printed on yellow.
4. A stamped and self-addressed return envelope.

The manager or owner was instructed to complete the employer questionnaire and to have a responsible agricultural-industrial equipment mechanic complete the employee questionnaire. The manager or owner was instructed to collect the employee questionnaire and return both the employer and employee questionnaire in the stamped and self-addressed return envelope by the date specified in the cover letter.

A follow-up of non-respondents consisted of mailing a packet of materials two weeks after the initial mailing. The first follow-up consisted of a packet of materials identical to the initial packet except that a cover letter on Ohio State University stationery replaced the cover letter on Association of Farm and Power Equipment Retailers in Ohio stationery.

A final follow-up of non-respondents was initiated four weeks after the initial mailing. A telephone contact by a project staff member was made with 50% of the non-respondents. The non-respondents were asked to complete the questionnaire and emphasis was placed on the importance of their participation to the success of the project during the telephone conversation.

Data Analysis

The 31 questionnaires which were returned were checked for completeness and accuracy by the project staff. Information from the 30 usable responses was coded on Fortran coding sheets for key punching. In addition to coding appropriate respondent background information, each specific task statement was coded as to

whether it was performed (1 = Task performed by respondent; blank = Task not performed by respondent) and the level of importance of the task (3 = Essential; 2 = Useful; 1 = Not Important). The information was keypunched on IBM cards and verified by personnel at the Instruction and Research Computer Center at The Ohio State University.

The data was analyzed using the SOUPAC computer program and the facilities of the Instruction and Research Computer Center. Consultant assistance for analyzing the data was provided by personnel at The Center for Vocational Education. The SOUPAC computer analysis resulted in the computation of relative frequencies, means, and rankings for each task statement. The results of the computer analyses were printed in tabular form for ease of interpretation.

FINDINGS

Objectives of the study resulted in the compilation of basic sample background information, the determination of tasks performed by the agricultural-industrial equipment mechanic, and the identification of tasks essential to successful performance as an agricultural-industrial equipment mechanic.

Description of the Sample

Information regarding the performance of tasks and the importance of the tasks to successful employment as an agricultural-industrial equipment mechanic was obtained from mechanics in various dealerships across Ohio.

Response to the Survey

A total of 70 questionnaires were mailed and 31 replies were received. This represented a 44.3% rate of return. The response to the questionnaire is summarized in TABLE I.

Size of Dealership

Mechanics from various size agricultural-industrial equipment firms were included in the study. The number of full-time equivalent (two one-half time mechanics equal one full-time equivalent) mechanics employed in the firm was used as an index to assess the size of dealership where the mechanic was employed. Of the 31 questionnaires received, 20 included information regarding the size of the dealership. TABLE II summarizes the responses to the question, "How many full-time equivalent mechanics are employed in your dealership?" Seven mechanics or 35% were

TABLE I

EMPLOYEE RESPONSE TO THE QUESTIONNAIRE

	N	Percent of All Employees In the Survey
Employees in Survey	70	100.0
Total Returns	31	44.3
Usable Returns	30	42.9
Unusable Returns	1	1.4
Nonrespondents	39	55.7

TABLE II

SIZE OF AGRICULTURAL-INDUSTRIAL EQUIPMENT SERVICE DEPARTMENT WHERE CURRENTLY EMPLOYED

Number of Mechanics Employed in Firm	N	Percent of Respondents
2	1	5.0
3	4	20.0
4	7	35.0
5	3	15.0
6	3	15.0
7 or more	2	10.0
Total	20	100.0

$\bar{X}$ number of mechanics in the firm = 4.7

employed in firms employing four full-time equivalent mechanics. Four mechanics or 20% were employed in firms employing three full-time equivalent mechanics. Thus, 55% of the mechanics were working in firms employing three to four full-time equivalent mechanics. The number of full-time equivalent mechanics employed in the dealerships ranged from 2-15. The average number of full-time equivalent mechanics employed in the firms was 4.7.

Total Work Experience

Mechanics with varying amounts of work experience in the agricultural-industrial equipment industry were included in the study. TABLE III summarizes the responses to the question, "How many total years have you worked in the agricultural-industrial equipment industry?" Seven mechanics or 23.2% had 23 or more total years of work experience in the agricultural-industrial equipment industry. Five mechanics or 16.7% had from four to six total years of work experience in the agricultural-industrial equipment industry. Five mechanics or 16.7% had from seven to ten total years of work experience in the agricultural-industrial equipment industry. Five mechanics or 16.7% had from 11-14 total years of work experience in the agricultural-industrial equipment industry. The total years of work experience in the agricultural-industrial equipment industry ranged from 1-48 years. Mechanics had an average of 15.0 years of total work experience in the agricultural-industrial equipment industry.

Employment at Current Job

Mechanics in the survey had spent varying amounts of time in their present job. TABLE IV summarizes the responses to the question, "How many years have you worked at your present job?" Seven mechanics or 23.3% had worked at their present job from seven to ten years. Six mechanics or 20% had worked at their present job from one to three years. Four mechanics or 13.3% had worked at their present job from four to six years. Four mechanics or 13.3% had worked at their present job from 11-14 years. The years of work at their present job ranged from 1-40 years. Mechanics had been employed at their present job an average of 12.0 years.

Preparation as a Mechanic

Mechanics obtained training for their job from various sources. TABLE V summarizes their responses to the question, "Where did you receive your training as a mechanic?" Thirty mechanics or 100% indicated they received training on-the-job. Twenty-six mechanics or 86.7% indicated they attended a company school or course to receive training as a mechanic. Nine mechanics or 30% indicated they had received training as a mechanic by attending a high school program in mechanics. Six mechanics or 20% indicated they had received training as a mechanic by attending a technical school program.

Duty Areas of Work Performed by the Mechanic

The 456 tasks were grouped under 24 duty areas. Each respondent indicated whether he performed the specific task in his

TABLE III

TOTAL AMOUNT OF WORK EXPERIENCE IN THE AGRICULTURAL-INDUSTRIAL EQUIPMENT INDUSTRY

Years	N	Percent of Respondents
1-3	3	10.0
4-6	5	16.7
7-10	5	16.7
11-14	5	16.7
15-18	3	10.0
19-22	2	6.7
23 or more	7	23.2
Total	30	100.0

$\bar{X}$ years in the industry = 15.0

TABLE IV

LENGTH OF TIME AT PRESENT JOB

Years	N	Percent of Respondents
1-3	6	20.0
4-6	4	13.3
7-10	7	23.3
11-14	4	13.3
15-18	2	6.7
19-22	2	6.7
23-26	2	6.7
27 or more	3	10.0
Total	30	100.0

$\bar{X}$ years at present job = 12.0

TABLE V

SOURCE OF TRAINING RECEIVED AS AN AGRICULTURAL-INDUSTRIAL EQUIPMENT MECHANIC

Source	N	Percent of All Employees In The Survey
On-The-Job	30	100.0
High School Program	9	30.0
Technical School Program	6	20.0
College/University Program	2	6.7
Adult Education Program	3	10.0
Company School/Course	26	86.7
Military Training	4	13.3
Other	4	13.3

current position as a mechanic. The percentages of respondents performing each task were averaged for all tasks under each duty area. The mean percentage of incumbents who performed specific tasks in specific duty areas is presented in TABLE VI.

Duty areas of work in which 50% or more of the incumbent workers performed the tasks were:

1. Performing General Office Procedures
2. Recording Information
3. Following General Safety Precautions
4. Pre-Delivery Servicing of Equipment
5. Using and Maintaining Hand and Power Tools
6. Operating Equipment and Vehicles
7. Using and Maintaining Service Manuals and Operator's Manuals
8. Picking-Up and Delivering Equipment
9. Assembling Equipment
10. Inspecting and Diagnosing Malfunctions
11. Repairing and Maintaining the Brake System
12. Repairing and Maintaining Wheels, Tires, and Tracks
13. Repairing and Maintaining the Steering System
14. Repairing and Maintaining the Air Conditioning System
15. Repairing and Maintaining the Power Train
16. Repairing and Maintaining the Hydraulic System
17. Repairing and Maintaining the Ignition, Charging, and Starting System
18. Repairing and Maintaining Electrical Accessories
19. Overhauling and Maintaining Engines
20. Repairing and Maintaining Governoring Systems

21. Repairing and Maintaining Oil Lubrication Systems
22. Repairing and Maintaining the Cooling System
23. Repairing and Maintaining Gas and Diesel Fuel Systems
24. Repairing and Maintaining Non-Power Equipment

Duty Areas of Work Essential for Successful Performance as a Mechanic

A level of importance rating was obtained for each task. The respondent could rate the task as essential, useful, or not important for successful performance as a mechanic. A ranking of essential was assigned a numerical rating of "3", useful a numerical rating of "2", and not important a numerical rating of "1". The level of importance ratings for each task were averaged for all tasks under each duty area. The average level of importance ratings for the specific tasks in the specified duty areas are presented in TABLE VI.

Duty areas of work which received a 2.0 or higher level of importance rating by incumbent workers were:

1. Performing General Office Procedures
2. Recording Information
3. Following General Safety Precautions
4. Pre-Delivery Servicing of Equipment
5. Using and Maintaining Hand and Power Tools
6. Operating Equipment and Vehicles
7. Using and Maintaining Service Manuals and Operator's Manuals
8. Picking-Up and Delivering Equipment
9. Assembling Equipment
10. Inspecting and Diagnosing Malfunctions
11. Repairing and Maintaining the Brake System
12. Repairing and Maintaining Wheels, Tires, and Tracks
13. Repairing and Maintaining the Steering System
14. Repairing and Maintaining the Air Conditioning System
15. Repairing and Maintaining the Power Train
16. Repairing and Maintaining the Hydraulic System
17. Repairing and Maintaining the Ignition, Charging, and Starting System
18. Repairing and Maintaining Electrical Accessories
19. Overhauling and Maintaining Engines
20. Repairing and Maintaining Governoring Systems
21. Repairing and Maintaining Oil Lubrication Systems
22. Repairing and Maintaining the Cooling System
23. Repairing and Maintaining Gas and Diesel Fuel Systems
24. Repairing and Maintaining Non-Power Equipment

Percentage Performance and Level of Importance Ratings of Specific Tasks

The percentage performance by incumbent workers and the level of importance for each specific task is also presented in TABLE VI.

It is recommended that the results for each specific task be examined by educators and others who are developing educational programs to determine curriculum content for preparing agricultural-industrial equipment mechanics. Specific tasks with a high level of performance and a high level of importance rating should be given more emphasis in the educational program than specific tasks with a low level of performance and a low level of importance rating.

TABLE VI

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE* OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Performing General Office Procedures		
File job sheets	53	2.2
Meet and work with people	93	2.9
Use telephone	93	2.6
Write memos and notes	59	2.4
File service manuals and operator's manuals	59	2.4
Use two-way radio	29	1.8
Mean Rating	64.3	2.4
Recording Information		
Record time and work performed on job sheets	89	2.9
Mean Rating	89.0	2.9
Following General Safety Precautions		
Apply first aid to minor cuts, bruises, and burns	86	2.6
Follow safe work habits	89	3.0
Identify potential safety hazards	83	2.8
Store chemicals	63	2.5
Use fire extinguishers	83	3.0
Wear appropriate protective clothing	79	2.6
Ventilate work areas	79	2.8
Interpret information on signs and labels	86	2.7
Use proper lifting and carrying methods	83	2.7
Store inflammable materials	63	2.6
Wear appropriate work clothes	86	2.5
Adjust safety devices	83	2.7
Install safety devices	79	2.7
Correct potential safety hazards	83	2.6
Remove debris from work areas	86	2.6
Use electrical connectors and safety devices	83	2.7
[illegible]an up chemical spills	73	2.7
Mean Rating	80.4	2.7

*Average rating of importance may range from 1-3 with 3 being the highest

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Pre-Delivery Servicing of Equipment		
Grease equipment	86	2.9
Inflate tires	88	2.8
Adjust belts	88	2.9
Adjust chains	83	2.9
Oil equipment	83	2.9
Mean Rating	85.6	2.9
Using and Maintaining Hand and Power Tools		
Adjust tools	86	2.9
Clean tools	89	2.9
Identify tools	83	2.8
Interpret tool operation instructions	83	2.8
Recondition broken hand tools	73	2.4
Select appropriate tools for specific jobs	89	2.9
Sharpen tools	86	2.5
Store tools	86	2.7
Use hand tools safely	93	2.9
Use power tools safely	93	2.9
Set up tools	79	2.5
Mean Rating	85.5	2.7
Operating Equipment and Vehicles		
Interpret gauges on equipment	96	3.0
Operate equipment and vehicles	96	2.8
Add wheel and front end weights	89	2.7
Adjust safety shields	93	2.9
Connect front end operated equipment	89	2.7
Connect hydraulic systems and hydraulic operated equipment	93	2.9
Correct potential equipment safety hazards	93	2.9
Connect 3-point hitch equipment	89	2.8
Hitch towed equipment	89	2.7
Identify potential equipment safety hazards	89	2.8
Install safety shields	89	2.9

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Interpret hand operating signals	83	2.7
Interpret safety and operating instructions in operator's manuals	89	2.9
Interpret equipment safety symbols	89	2.8
Operate equipment under working conditions	79	2.6
Refuel power units	83	2.5
Mean Rating	89.2	2.8
Using and Maintaining Service Manuals and Operator's Manuals		
Locate proper specifications for equipment	96	3.0
Locate appropriate manuals for specific equipment	93	2.9
Interpret sketches and diagrams	93	2.8
Follow written repair procedures	93	2.9
Mean Rating	93.8	2.9
Picking-Up and Delivering Equipment		
Complete delivery report	46	2.4
Identify locations for pick-up and delivery	69	2.5
Select proper delivery route	63	2.4
Secure equipment on truck with chains and binders	76	2.8
Load truck according to vehicle load limits	59	2.6
Load and unload items on truck	76	2.6
Hitch equipment to truck for delivery	76	2.6
Describe use of equipment operator's manual to customer	89	2.7
Describe general equipment operating procedures to customers	86	2.8
Describe general equipment maintenance procedures to customers	89	2.8
Mean Rating	72.9	2.6
Assembling Equipment		
Install belts	83	2.9
Install chains	83	2.9
Install controls	86	2.9

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Check packing list against parts and hardware in bundles	79	2.6
Follow written assembly instructions	83	2.9
Identify and use appropriate hardware items for assembly	83	3.0
Inspect assembled equipment for operating defects	86	2.9
Interpret assembly diagrams	83	2.9
Use proper tools and equipment to assemble	83	2.8
Separate hardware items into piles	73	2.4
Arrange parts for ease in assembly	79	2.5
Tighten bolts in proper sequence	86	2.9
Inspect parts for damage	86	2.9
Mean Rating	82.5	2.8
Inspecting and Diagnosing Malfunctions		
Determine how breakages or defects in specific parts influence overall operation of equipment	79	2.7
Determine potential causes of equipment failure from customer's description	89	2.7
Diagnose potential causes of equipment failure from symptoms observed	89	2.9
Visually inspect for defects	89	2.8
Interpret maintenance procedures for customers to prevent operating defects	89	2.7
Recommend appropriate parts needed to correct equipment malfunctions	93	2.8
Follow troubleshooting procedures in service manuals	93	2.9
Operate equipment to identify potential defects	93	2.8
Connect, operate, and disconnect testing equipment	93	3.0
Run dynamometer test	93	2.8
Use oscilloscope and engine analyzer to test engine	43	2.2
Use hydraulic system tester on hydraulic system	89	2.9
Mean Rating	86.0	2.8
Repairing and Maintaining the Brake System		
Adjust mechanical brakes	93	2.9
Adjust power brakes	93	2.9

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Bleed power brakes	93	2.9
Inspect backing plate, brake disk, pressure plates, and brake pistons	93	2.9
Replace brake lining	89	2.7
Replace brake springs, pins, and/or balls	89	2.9
Remove and install cylinders, shoes, and disk	89	2.9
Test brakes after adjustment	89	2.9
Mean Rating	91.0	2.9
Repairing and Maintaining Wheels, Tires, and Tracks		
Add wheel weights	76	2.4
Adjust track tension	59	2.3
Adjust wheel bearings	86	2.9
Adjust wheel width	86	2.7
Inflate tires	88	2.8
Inspect bearings and seals	89	2.9
Inspect track pins and bushings	53	2.2
Load tires with liquid	56	2.0
Patch tubes	59	2.3
Remove and install track	39	2.0
Repack wheel bearings	89	2.8
Replace wheel bearings and seals	89	2.8
Mean Rating	72.4	2.5
Repairing and Maintaining the Steering System		
Adjust steering gear bearings	89	2.9
Adjust toe-in, drag link, and turning angle	93	2.9
Bleed power steering system	83	2.7
Inspect power steering motor assembly	89	2.8
Inspect power steering system for leaks	93	2.9
Inspect power steering valve assembly	93	2.9
Inspect steering gears	93	2.9
Install and adjust power steering pump belt tension	93	2.9
Remove and install ball joints	89	2.7
Remove and install power steering motor	86	2.8
Repair power steering valve assembly	86	2.8

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Remove and install power steering valve assembly	86	2.9
Remove and install tie rods	89	2.8
Repair power steering motor	83	2.7
Replace steering gears and knuckles	86	2.8
Mean Rating	88.7	2.8
Repairing and Maintaining the Air Conditioning System		
Add oil to compressor	59	2.6
Charge the system	50	2.5
Clean the air filters	73	2.7
Discharge the system	53	2.4
Evacuate the system	50	2.5
Inspect operation of air ducts and louvers	69	2.5
Inspect system for leaks	69	2.6
Install and adjust compressor drive belts	79	2.6
Remove and install compressor	73	2.6
Remove and install evaporator	46	2.4
Remove and install expansion valve	46	2.4
Mean Rating	60.6	2.5
Repairing and Maintaining the Power Train		
Add and remove shims in power train	86	2.9
Adjust accumulator charging orifice	50	2.3
Adjust differential lock control valve	66	2.7
Adjust oil pressure regulating valve on power shift transmission	69	2.8
Adjust shifter linkage rod	86	2.9
Adjust transmission clutch operating levers	83	2.9
Check and adjust clutch pedal free travel	89	3.0
Check and adjust end-play on gears and shafts	89	3.0
Check and adjust gear backlash	89	3.0
Check spline wear	89	2.9
Conduct drag test on power shift transmissions	56	2.6
Determine purpose of power train parts	86	2.7
Evaluate how contaminants influence tooth and gear wear	83	2.6
Check flywheel friction surface	89	2.8

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Identify gear tooth wear and failures	89	2.7
Identify parts of power train	89	2.9
Identify types of transmissions	89	2.8
Inspect clutch shafts and forks	89	3.0
Inspect parts of clutch operating sleeve assembly	86	2.8
Inspect clutch housing	89	2.7
Inspect PTO clutch lever assembly	89	2.9
Inspect clutch pilot bearing	89	3.0
Inspect clutch disks	89	2.9
Inspect clutch springs	89	2.9
Inspect speed change shifter yokes, shafts, pawls, and cams	69	2.7
Inspect transmission drive shaft, countershaft, and differential shaft	89	3.0
Inspect components of power transmission oil pump	83	2.9
Inspect components of power shift transmission valve assembly	79	2.8
Inspect components of planetary pack from power shift transmission	86	2.9
Inspect components of differential	89	2.9
Inspect components of planet carrier assembly and rear axle	83	2.8
Inspect PTO bearings	89	2.9
Inspect clutch disks	89	2.9
Install PTO safety shields	89	2.9
Replace PTO universal joints	89	2.8
Drain, flush, and refill transmission	89	2.9
Pre-load gear train	89	3.0
Check and adjust PTO clutch lever free travel	86	2.9
Pack bearings	89	2.9
Remove and install transmission and PTO clutch shafts and forks	89	3.0
Remove and install clutch operating sleeve assembly	89	3.0
Replace clutch release thrust bearing	89	3.0
Replace bushings in clutch assembly	86	3.0
Replace oil seals, O-rings, and packing in clutch assembly	89	3.0
Remove and install PTO clutch lever assembly	86	2.8
Remove and install clutch pack assembly	86	2.9
Remove and install flywheel	89	2.9
Remove and install pilot bearing and thrust washer	89	2.9
Remove and install clutch disk	89	2.8

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Remove and install clutch plates	86	2.9
Remove and install clutch springs	79	2.8
Reline clutch disk	69	2.6
Remove and replace electric clutch controls	66	2.7
Remove and replace hydraulic clutch controls	86	2.9
Replace transmission oil seals	89	2.9
Open transmission case	89	2.8
Remove and install speed range and change shifters	83	2.8
Remove and install transmission drive shaft	89	2.9
Remove and install shifter yokes, shafts, pawls, and cams	86	2.8
Remove and install differential drive shaft	89	2.9
Remove and install transmission countershaft	89	2.9
Replace bearings in transmissions	89	2.9
Remove and install power transmission oil pump	89	2.9
Replace parts of power transmission oil pump	86	2.9
Replace transmission oil filter	89	2.9
Replace gaskets in transmission	89	2.9
Remove and install power shift transmission valves	86	3.0
Replace components of power shift transmission valve assembly	83	2.9
Remove and install planetary pack in power shift transmissions	89	2.9
Replace components of planetary pack from power shift transmission	86	2.9
Remove and install differential	89	2.9
Replace ring gear, bevel gears and pinion	89	3.0
Remove and install rear axle	89	2.8
Remove and install planet pinion carrier assembly	89	2.9
Replace axle oil seals	86	2.8
Replace and adjust axle bearings	89	2.9
Replace PTO bearings	89	2.9
Replace PTO gears	89	2.9
Separate and rejoin tractor	89	2.9
Test field coil and electromagnetic clutch	69	2.5
Test assembled planetary pack from power shift transmission	76	2.7
Mean Rating	85.1	2.9
Repairing and Maintaining the Hydraulic System		
Add hydraulic oil to system	89	2.9

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Bleed hydraulic system or remote cylinders	86	2.8
Determine purpose of hydraulic system parts	89	2.9
Diagnose pump failures	89	2.9
Drain, clean, flush, and refill hydraulic system	89	2.9
Evaluate influence contaminants have on operation of hydraulic system	79	2.7
Identify parts of hydraulic systems	89	2.9
Identify types of hydraulic pumps	89	2.8
Identify types of hydraulic systems	86	2.8
Inspect and clean oil cooler	89	2.8
Inspect components of pumps and motors	86	2.8
Inspect hydraulic valves and valve springs	86	2.9
Install O-rings, seals, and packing	89	3.0
Locate internal and external leakage problems	89	3.0
Measure pump and motor tolerances	89	2.9
Read schematic of hydraulic systems	93	2.9
Remove and install hydraulic hoses or tubing	89	2.9
Remove and install hydraulic pumps	89	2.8
Remove and install hydraulic oil cooler	89	2.8
Remove and install hydraulic relief valves, check valves, bypass valves, and control valves	89	2.8
Replace and adjust components of hydraulic valves	89	2.8
Replace and adjust pump wear plates	89	2.8
Replace cylinder barrels and cylinder rods	89	2.9
Replace hydraulic oil filters	89	2.9
Test valve cartridges for pressure setting	83	2.9
Mean Rating	87.6	2.9
Repairing and Maintaining the Ignition, Charging, and Starting System		
Adjust regulator air gap	76	2.6
Check for spark	89	3.0
Check ignition resistor with ohmmeter	73	2.7
Check specific gravity of battery	89	2.8
Check timing	89	3.0
Clean and inspect distributor cap, rotor, and housing cover	89	2.9

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Clean regulator contact points	79	2.6
Clean starter drives	89	2.8
Conduct generator output test for amperage, voltage, and resistance	83	2.9
Conduct regulator current test	76	2.8
Conduct regulator voltage test	76	2.8
Determine purpose of parts in the system	89	2.9
Identify parts of the system	89	2.9
Inspect breaker points	89	2.9
Inspect components of distributor	89	2.9
Inspect components of starter	89	2.9
Inspect for poor electrical connections	89	3.0
Inspect parts of generator	89	2.9
Inspect the wiring harness for broken wires	89	3.0
Inspect spark plugs	89	2.9
Inspect switches	89	3.0
Install and adjust breaker points	89	3.0
Install and adjust generator belts	89	2.9
Install and adjust spark plug	89	3.0
Install and service battery	89	2.9
Make no load test on starter	79	2.6
Polarize the generator	86	3.0
Read electrical schematic drawings	86	2.8
Rebuild distributor or replace distributor parts	86	2.9
Remove and install distributor	89	2.9
Remove and install generator	89	2.9
Remove and install regulator	89	2.9
Remove and install solenoid	89	2.9
Remove and install starter	89	2.9
Replace generator bearings	89	2.8
Replace generator brushes and springs	89	2.9
Replace spark plug wires	89	2.9
Replace starter brushes	89	2.8
Replace starter bushing	89	2.7
Take voltage drop tests	76	2.7
Test coil polarity	76	2.7
Test coil when cold and hot	83	2.6
Test condensor for resistance, leakage, and capacity	76	2.6
Test distributor with distributor tester	59	2.6
Test generator armature for open circuit, ground, or short circuit in windings	73	2.7

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Test generator field coils for grounds or open circuits	76	2.6
Test ignition system for open circuits, grounds, and resistance with voltmeter	79	2.7
Test solenoid for resistance and voltage draw	59	2.6
Test solenoid switch circuit	79	2.7
Test starter armature and field coils	79	2.7
Test for oxidized regulator points	79	2.6
Time ignition system to engine	86	2.9
Unlock starter	89	2.7
Use voltmeter to check battery voltage	86	2.9
Wire the ignition, charging, and starting circuits	89	2.9
Replace field windings in starter	59	2.3
Replace ignition switches	89	2.9
Mean Rating	83.6	2.8
Repairing and Maintaining Electrical Accessories		
Adjust headlights	83	2.4
Install wiring harness	89	3.0
Repair broken electrical wires	89	2.9
Replace circuit breakers	86	2.9
Replace fuses	89	2.9
Replace fuse blocks	86	2.9
Replace gauges	89	2.9
Replace lenses	89	2.8
Replace light bulbs	89	2.8
Replace speedometer cable and housing	89	2.8
Replace switches	89	3.0
Replace warning devices	89	3.0
Test circuits for shorts, grounds, and open circuits	89	3.0
Test operation of gauges	89	2.8
Test solenoids	79	2.8
Mean Rating	87.5	2.9
Overhauling and Maintaining Engines		
Adjust valve clearance	89	3.0
Check compression	89	3.0

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Clean engine and engine parts	89	2.9
Clean head	89	2.9
Clean oil and water passages	89	2.9
Deglaze cylinders	86	2.8
Determine function of engine parts	89	2.9
Grind valves	89	2.9
Identify parts of engine	89	3.0
Install head gasket	89	3.0
Install valve guides	86	2.9
Inspect and measure camshaft bushings	89	2.9
Inspect and measure valve seats	86	2.9
Inspect and replace gaskets	89	3.0
Inspect and replace valve springs	89	3.0
Inspect camshaft and measure camshaft tolerances	86	2.9
Inspect camshaft gear	89	3.0
Inspect components of rocker arm assembly for defects	89	3.0
Inspect crankshaft and measure tolerances	89	3.0
Inspect crankshaft gear	89	3.0
Inspect cylinder and measure cylinder bore	89	2.9
Inspect engine block	89	2.9
Inspect flywheel	89	2.9
Inspect head and head gasket	89	3.0
Inspect main bearings and measure main bearing clearance	89	3.0
Inspect connecting rods and measure rod bearing clearance	89	3.0
Inspect pistons and measure piston tolerances	89	3.0
Inspect piston pins and measure pin tolerances	89	3.0
Inspect piston rings and measure piston ring tolerances	89	3.0
Inspect ring gear	89	2.9
Lap valves	73	2.6
Measure camshaft end play	83	2.9
Measure crankshaft end play	83	2.9
Measure oil slinger run-out	66	2.5
Measure valve guide tolerances	79	2.8
Rebore cylinders	36	2.1
Reface valve seats	76	2.8
Remove and install camshaft	89	3.0
Remove and install camshaft bushings	86	2.8
Remove and install camshaft gear	89	3.0
Remove and install crankshaft	89	3.0

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Remove and install crankshaft gear	89	2.9
Remove and install cylinder liners	89	3.0
Remove and install engine	89	3.0
Remove and install front and rear oil seals	89	3.0
Remove and install head	89	3.0
Remove and install piston assembly	89	3.0
Remove and install piston rings	89	3.0
Remove and install piston pins	89	2.9
Remove and install oil pan	89	2.9
Remove and install valves	89	2.9
Remove and install valve seat inserts	66	2.6
Remove and install rocker arm assembly	89	3.0
Remove and install rocker arm cover	89	3.0
Remove and install timing chain	79	2.8
Remove and install oil slinger	86	2.8
Remove and install rod bearing inserts	89	2.9
Remove cylinder ridge	86	3.0
Remove or add shims	86	2.9
Remove and replace main bearings	89	3.0
Remove and replace flywheel	89	2.9
Remove and replace ring gear	89	2.9
Replace piston pin bushings	69	2.7
Separate and rejoin tractor	89	2.9
Torque rod bearing caps	89	3.0
Torque main bearings	89	3.0
Torque head bolts	89	3.0
Time valve assembly	86	3.0
Mean Rating	86.0	2.9
Repairing and Maintaining Governoring Systems		
Adjust for proper engine speed	89	3.0
Inspect components of governor	86	3.0
Inspect components of ventilator pump	69	2.7
Measure idler gear end play	86	2.8
Remove and install governor and/or ventilator pump	86	3.0
Remove and install governor needle bearings	86	3.0
Remove and install ventilator pump idler gear assembly	66	2.5

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Replace governor thrust bearings and weights	89	2.9
Mean Rating	82.1	2.9
Repairing and Maintaining Oil Lubrication Systems		
Add oil to engines	89	2.9
Change oil and oil filters	89	2.8
Check and adjust oil pressure	89	2.9
Clean diesel engine oil cooler	83	2.8
Inspect components of oil pump	86	2.9
Remove and install diesel engine oil cooler	89	2.9
Remove and install oil pump	89	2.9
Replace drive gear and shaft	89	2.9
Replace idler gear	86	2.8
Mean Rating	87.7	2.9
Repairing and Maintaining the Cooling System		
Add coolant to system	89	2.9
Back flush cooling system	76	2.6
Clean cooling system with commercial cleaners	76	2.6
Inspect and test system for leaks	89	3.0
Inspect components of water pump	89	2.9
Install and adjust fan belt	88	2.9
Remove and install fan	86	2.8
Remove and install radiator	89	2.9
Remove and install thermostats	89	2.9
Remove and install water pump	89	2.9
Replace water pump impeller	86	2.7
Replace water pump seal and bearing	86	2.7
Replace radiator hoses	89	3.0
Test thermostats	86	2.7
Mean Rating	86.2	2.8
Repairing and Maintaining Gas and Diesel Fuel Systems		
Adjust carburetors	89	3.0
Bleed diesel fuel system	89	2.9

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Clean carburetor	89	2.9
Clean sediment bowl and screen	89	3.0
Determine purpose of various parts	89	2.9
Identify parts of fuel system	89	2.9
Inspect carburetor parts for defects	89	3.0
Inspect manifolds	89	3.0
Install carburetor repair kit	89	2.9
Remove and install diesel fuel pump	89	2.9
Remove and install fuel tank	89	2.8
Remove and install gas fuel pump	86	2.8
Remove and install manifolds	89	2.9
Remove and install injection nozzles	89	2.9
Repair injection nozzles	76	2.8
Replace fuel filters	89	2.9
Replace fuel lines	89	2.9
Replace fuel system warning devices	79	2.7
Replace needle bearings	86	2.8
Run manifold vacuum test	79	2.8
Service air cleaner	89	3.0
Test diesel fuel injection pump	59	2.5
Test fuel pump	73	2.5
Test injection nozzles	89	2.8
Time injection pump	89	2.9
Mean Rating	85.6	2.9
Repairing and Maintaining Non-Power Equipment		
Cut metal	83	2.5
Heat and bend metal	83	2.5
Identify various metals	59	2.3
Operate arc welder	79	2.5
Operate oxy-acetylene welder	76	2.5
Prepare and fit metal to be welded	83	2.5
Repair and maintain agricultural harvesting equipment	83	2.7
Repair and maintain agricultural labor saving and materials handling equipment	76	2.6
Repair and maintain agricultural planting equipment	76	2.6
Repair and maintain agricultural spraying equipment	69	2.5

TABLE VI (Cont.)

PERCENTAGE PERFORMANCE AND AVERAGE RATING OF IMPORTANCE OF SPECIFIC TASKS

TASK STATEMENTS	Percent Performing	Average Level of Importance
Repair and maintain agricultural tillage equipment	73	2.7
Weld metal	79	2.5
Mean Rating	76.6	2.5